



Wait, Wait, Don't Launch!

Delivery On-Orbit

Risk is inherent in space missions. Not only is it dangerous and full of unknown things but even the known things are risky, could fail, or encounter that 1/1000 chance of failure. A big portion of the risk is simply getting there—getting to orbit. Once a satellite is on—orbit and functioning (all its systems have been checked out) it usually lasts well longer than the minimal planned operational life. That's because NASA satellites are built tough, built with redundancy in critical systems and thoroughly tested all the way through design, fabrication and integration.

If the government could off-load the risk of getting to orbit, perhaps it could focus on its core business of science satellites and the instruments they contain? Goddard was so directed to look at some innovative types of contracts that would require the contractor to deliver the spacecraft not to the launch site but to the *on-orbit* site. This would mean that the contractor would have all the risk of launch, achieving orbit and check out of instruments and spacecraft. If any of that didn't work, the contractor could be liable for a replacement spacecraft.

Following this new direction, Goddard awarded a firm-fixed price (FFP) contract for a series of weather spacecraft and their related instruments. The contract stipulated that the government would take possession of (and thus pay the final contract installment) only after the satellites had achieved orbit and been checked out—about 90 days after launch. Since the Contractor was to bear the risk of any launch failure, the Contractor also assumed responsibility for the launch decision process with respect to the spacecraft and mission success. Range safety including public safety, is never delegated and is always retained by the range commander. Not much thought was given to launch issues as the spacecraft wound its way through integration heading towards a date at the launch pad.

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A few months before the scheduled launch date, in preparation for the launch campaign, engineers working for the Government realized that during a launch countdown itself, the Government would have no voice to stop the launch for any issue relating to mission success. The only mechanism the government had to control the contractor was a ‘stop-work’ order requiring the contractor to cease all activity and incur no more costs to the contract. A ‘stop-work’ order is a fairly drastic measure used when there is a significant dispute, poor quality work or some other failure to perform as per the contract. It is generally not a tool for expressing differences of opinion or making launch decisions as it can take time to execute.

With the rocket ready to go during the countdown to launch of the satellite, a telemetry reading was documented as out of limit. The telemetry reading was a launch commit criteria¹ (LCC) but the Contractor contended that the Government’s limit was too restrictive and that the Contractor’s internal standard was not violated. Based on their own risk assessment the Contractor did not believe the out of limit reading required them to scrub the launch and they therefore proceeded with the countdown. As the Government had no decision authority in the polling² process, they had to scramble to get the Contracting Officer to issue a stop work order which was accomplished just minutes prior to ignition. The technical issue was resolved and the satellite was re-manifested for a second launch attempt. The second launch attempt did not produce any problems or issues and the satellite was successfully launched.



Figure 1. The Delta IV rocket for GOES-N, Launch Complex 37 at Cape Canaveral Air Force Station ready for launch.

A couple of months following the launch, a certified claim for \$50M was received by the Government for the

¹ Launch Commit Criteria (LCC) are carefully agreed to standards that are monitored during a launch sequence. If any of the LCC are violated (out of normal) the launch is to be scrubbed without discussion. LCC are considered essential for launch safely to avoid launch fever (the psychological pressure to get it over with) and the possibility of making ill-informed quick decisions in the countdown process. For more on LCC see the Atlas AC-67 case study.

² The “Polling Process” is when at various times during the launch , the Launch Director ‘polls’ or asks each system area (safety, weather, communications, navigation, propulsion, etc.) whether the systems they represent are ‘go for launch.’ With the contractor being responsible for the launch, no Government representative of the mission was included in this poll and thus could not object to their own LCC violation.

issuance of the stop work order and the delay from the first launch attempt. At that time, the contract was valued at approximately \$750M. It took two years to settle the legal claims and impacted several other 'delivery on orbit' missions under way. Many in the Government considered that they had received a 'good value' on the Firm-Fixed-Price contracts. The System Engineer reflected on the events:

"Our engineers are trained to design and build the best stuff and to make sure it works by testing it rigorously, and while cost/schedule is important, not to compromise mission requirements to make the right engineering decision. Over the course of the year between the initial attempt to launch in August 2005 and its successful launch in May 2006, there were numerous times where there were pulls from the "business side" that needed to be factored in when making a go-forward decision - more so than under a "Cost Plus" arrangement. "Stay on Pad" or "Come Back and Test" are tough enough decisions, but factor in "You stop - You Pay" and equations/temperaments change. During a launch campaign, do we really want to have NASA engineers, managers and contracting personnel playing "launch chicken" with our Prime Contractors over "good business strategies" or have them be "100% focused on mission success?"



Figure 2. The Delta IV rocket ascending with the GOES-N satellite.

The contract contained the standard FAR Stop Work Clause.

52.242-15 Stop-Work Order (Aug 1989)

(a) The Contracting Officer may, at any time, by written order to the Contractor, require the Contractor to stop all, or any part, of the work called for by this contract for a period of 90 days after the order is delivered to the Contractor, and for any further period to which the parties may agree. The order shall be specifically identified as a stop-work order issued under this clause. Upon receipt of the order, the Contractor shall immediately comply with its terms and take all reasonable steps to minimize the incurrence of costs allocable to the work covered by the order during the period of work stoppage. Within a period of 90 days after a stop-work is delivered to the Contractor, or within any extension of that period to which the parties shall have agreed, the Contracting Officer shall either—

(1) Cancel the stop-work order; or

(2) Terminate the work covered by the order as provided in the Default, or the Termination for Convenience of the Government, clause of this contract.

(b) If a stop-work order issued under this clause is canceled or the period of the order or any extension thereof expires, the Contractor shall resume work. The Contracting Officer shall make an equitable adjustment in the delivery schedule or contract price, or both, and the contract shall be modified, in writing, accordingly, if—

(1) The stop-work order results in an increase in the time required for, or in the Contractor's cost properly allocable to, the performance of any part of this contract; and

(2) The Contractor asserts its right to the adjustment within 30 days after the end of the period of work stoppage; provided, that, if the Contracting Officer decides the facts justify the action, the Contracting Officer may receive and act upon the claim submitted at any time before final payment under this contract.

(c) If a stop-work order is not canceled and the work covered by the order is terminated for the convenience of the Government, the Contracting Officer shall allow reasonable costs resulting from the stop-work order in arriving at the termination settlement.

(d) If a stop-work order is not canceled and the work covered by the order is terminated for default, the Contracting Officer shall allow, by equitable adjustment or otherwise, reasonable costs resulting from the stop-work order.